Greenhouse Aquaponics Proposal

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The Project Rundown

This project has the goal of building a modular aquaponics system out of affordable parts in one of Union College's currently unused Greenhouses, supplemented with an autonomous system to monitor plant growth and adjust nutrients. This system will provide produce for campus, require little to no maintenance, and provide a testing ground for student research on campus. The assembly procedure will be condensed into a manual, which will be made readily available to people in disaster situations to enable them a source of fresh food.

What is Aquaponics?

Aquaponics is an agricultural system that utilizes fish and ambient bacteria to provide an ideal nutrient water solution to the plants being grown. Once the fish are fed, they produce ammonia, which is then converted to nitrite, and finally nitrate via bacteria. This would usually need to be filtered out to keep the fish alive, but in an aquaponics setup, the nutrient enriched water gets pumped through the roots of the plants, which are kept in a non absorbing medium, allowing the plant to absorb exactly what it needs to thrive, and making the water safe for the fish. This system has the single input of fish food, and the output of produce.

This system is the focus for a lot of research done by NASA, as it is an ideal setup for extraterrestrial colonization, and for providing food on long term space flights.

Why Aquaponics?

Growing plants with this method has numerous benefits over in-soil farming for both production and environmental factors. Loss of crops is significantly decreased due to a near complete control over the surrounding climate and provided nutrients. This also means that these plants are not depleting the nutrients in the soil, which eliminates the need for artificial supplicants or fixing crops. Due to the entire system being a closed water cycle, the only water lost is due to evaporation, which is kept minimal due to climate conditioning. This contrasts traditional farming, in which over 90% of provided water is lost through soil absorption, which causes further issues with erosion, also eliminated in this system. Since the ratio of nutrients in the water solution are precisely controlled to fit the plants needs, growth is accelerated, and production is increased, and because this is aquaponics, there is also a steady supply of fish once they reach maturity. Due to the self-contained and modular system for the individual plants, they can be placed in any arrangement in 3D space, allowing for a very efficient use of land.

Budget

Part	Price ($)	How Many	Total price for part ($)	Full price ($)
5 gallon bucket	5	10	50	1998.62
Tomato Plant	10	10	100	
Grow Light	79	3	237	
pump	43	1	43	
pi	35	2	70	
picam	10	2	20	

relay	15	1	15	
pipe	3	30	90	
medium	17.88	19	339.72	
fish tank (275 gallon)	200	1	200	
fish	4.14	35	144.9	
Various electronics	225	1	225	
Various piping and tubing	100	1	100	
Various sealants	100	1	100	
1 generations of fish food	122	2	244	
API Freshwater Test Kit	20	1	20	

Table 1: Budget proposal for Aquaponics Setup

Design

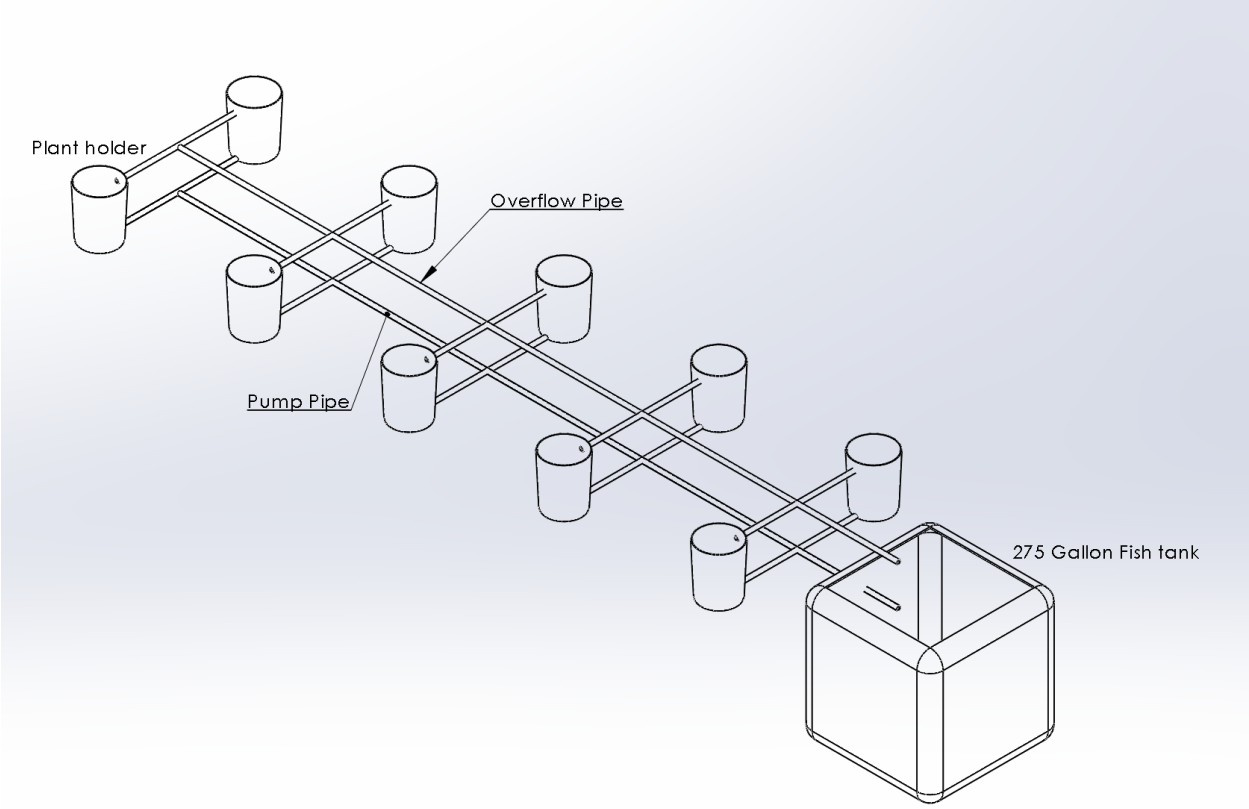

Figure 1: Layout Diagram for Aquaponics Setup

The fish tank will be kep below the plants, allowing the overflow from the pumped up water to drop down back into the tank, oxygenating the water. Raspberry Pi's with cameras and sensors will be constantly monitoring the system, and will use machine learning to recognize when there

is ripe produce, and send out notifications. The Raspberry Pi's will also graph out the water's nutrients levels, and regulate the feeding of the fish, eliminating almost any maintenance.

Timeline

Day #	Milestone
-14	Materials arrive
0	System is completed
21	Automation advances
50	Tomatoes start fruiting
110	Tilapia mature
120	System Expanded or completion of manual

Table 2: Timeline for completion

Anticipated Outcomes

Once the initial setup of the system has reached a self sustaining stage, a greater variety of vegetation can be integrated due the the modular design of the system. This will continue to grow produce over the course of an entire year, and provide a similar function to the Octopus' garden, with the added benefit of it being more efficient, and better for the environment.

Due to aquaponics being a nearly closed system, it is also an ideal place for students to perform research on any section of the nutrient cycle. Additionally, due to the integrated automation, students will be able to design new code or machinery to better the design as a research project, or potentially as learning material in class.

Upon the completion of first section of the system, all documentation and planning from the building will be compressed into a manual for replicating the system using easy-to-find parts, and published under an open source license. This instruction set will be designed with simplicity in mind, and with the goal of an easily implementable system in any area where fresh food is scarce. This includes impoverished areas, places with contaminated soil, and locations struck by natural disaster. With these instructions being open source, people will continue to improve the design, and due to the simplicity of the parts, disaster relief packages with the equipment required to build this system will be easy to assemble and ship out.